

Instructions: When faced with a table and lots of text, scan the text looking at the first and last sentences, and browsing for important words and underlining them. When looking at the Figures, make sure you examine the variables (x and y axes) to see what is being shown. If there is a Figure Caption (like there is in this problem), be sure to read the Figure Caption. DO NOT spend too much time on any one question. If you don't get it right away, move on. Be sure to **CROSS-OUT** answers that don't match. Remember, you do NOT need to know ANYTHING about the science topic to do well on the ACT Science section. It is a reading test.

PASSAGE VI

Ionization energy is the amount of energy needed to take one electron from the outer shell of an elemental atom. Ionization energies are measured by removing successive electrons from the shells of an atom. The energy needed to withdraw the first electron is termed the first ionization energy, and each successive stage of electron withdrawal—named the second or third ionization energy, accordingly—requires more energy than the stage preceding it. Yet, an atom just beginning a new shell or subshell will have a smaller first ionization energy than the atom preceding it.

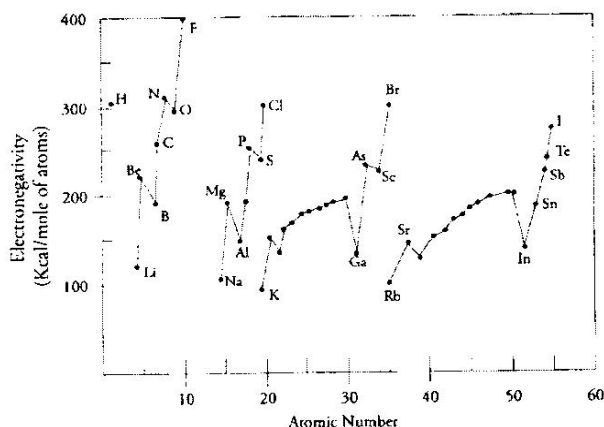


Figure 1

Figure 1 shows the first ionization energies (Kcal/mole of atoms) of the first 53 elements on the periodic table. Each of the first five periods is represented by a line connecting the elements of that period. The first period, containing only hydrogen, is represented by a dot. The noble gases are excluded.

If an element has a low first ionization energy, the atom is likely to form a positive cation, while an element with a high first ionization energy is less likely to lose an electron and more likely to form a negative anion. Also, metals tend to have lower first ionization energies and tend to give away electrons, forming positive cations. Figure 2 shows an expanded graph of Group IA to give a clearer representation of the trend down a group on the periodic table.

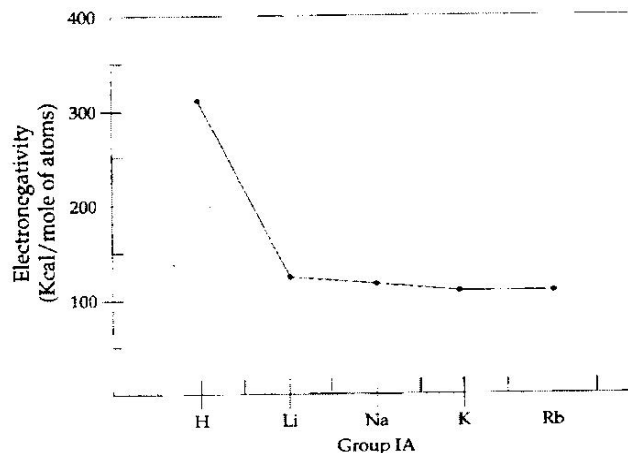


Figure 2

4. Using Figure 2, predict the approximate first ionization energy for Cesium (Cs), element #55 (Group IA, Period 6)

- A. 55 B. 90 C. 160 D. 280

5. Hydrogen (H), element #1, has a high first ionization energy compared to Lithium (Li), element #3, although they both have only one electron in their outermost shell. What is a possible explanation for this phenomenon?

- F. Hydrogen is heavier than lithium.
 G. Hydrogen has fewer shells than lithium, and its nucleus exerts a greater comparative force on its one electron.
 H. In a vacuum, hydrogen and lithium would have the same first ionization energy.
 J. Hydrogen is an anomaly, and it is usually not included in first ionization energy charts.

Questions: (use information ONLY from the reading and graphs to answer)

1. Some cations and anions will form ionic bonds with each other. Which of the following pairs of atoms could form a cation and an anion pair, respectively?

- F. Na and Mg G. Na and K
 H. Br and I J. Li and F

2. As a general trend, the lower the first ionization energy, the more metallic character the element exhibits. According to Figure 1, which three elements are the MOST metallic?

- A. Na, K, Rb B. Li, Na, Al
 C. In, Ga, Sr D. F, Cl, O

3. Comparing the first ionization energies of Mg and Al, what is a possible explanation for their different values?

- F. Mg > Al because Mg contains more electrons than Al.
 G. Mg > Al because Mg is more metallic and more energy is required to remove its outermost electron.
 H. Mg > Al because Al represents a new subshell and less energy is required to remove its outermost electron.
 J. Al > Mg because each successive ionization stage requires more energy.